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(71) Applicant(s)
PolyOil Limited
(Incorporated in the United Kingdom)
Sonas House, 12c Clarendon Place, STIRLING, GK8 2QW, United Kingdom

(72) Inventor(s)
Harry Whitelaw

(74) Agent and/or Address for Service
Kennedys
Floor 5, Queens House, GLASGOW, G1 2DT, United Kingdom

(54) Abstract Title
Polyamide Casing Centraliser

(57) A casing centraliser 1 comprises an annular body 2 with a plurality of ribs 3 extending longitudinally on the outer surface. A longitudinal bore extends through the annular body 2. The centraliser 1 is formed by casting a polyamide material, preferably using a monomer casting technique with centrifugal or gravity poured raw material. The ribs 3 may be hollow and contain ports 4 which allow the circulation of fluid through the ribs 3. Conduction means such as power lines or optical fibres may be contained within the ribs 3. The ribs 3 may also spherical members (8, fig 3) to reduce friction with the wellbore in use.

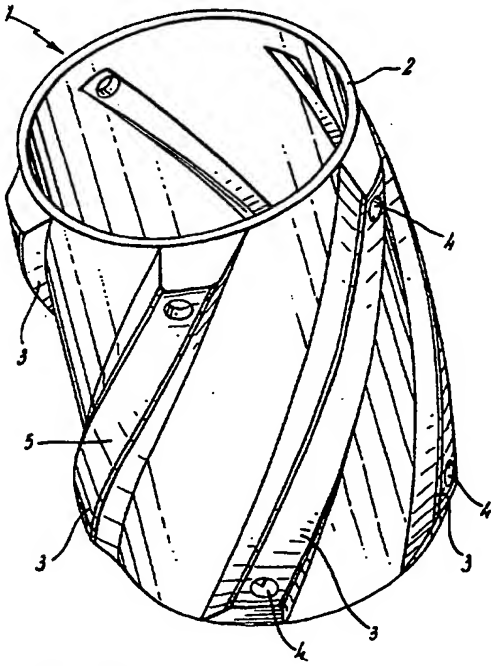

Fig.1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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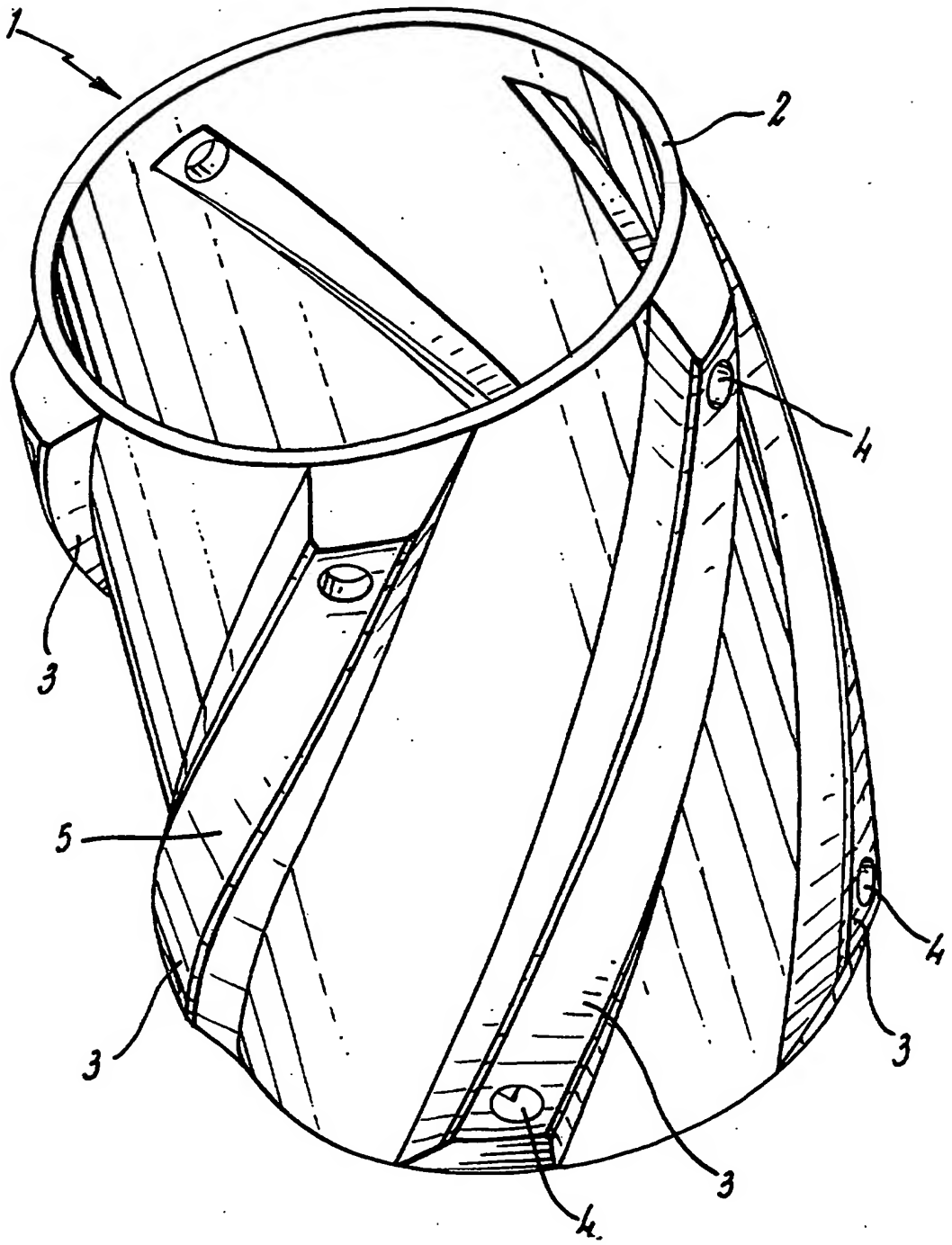
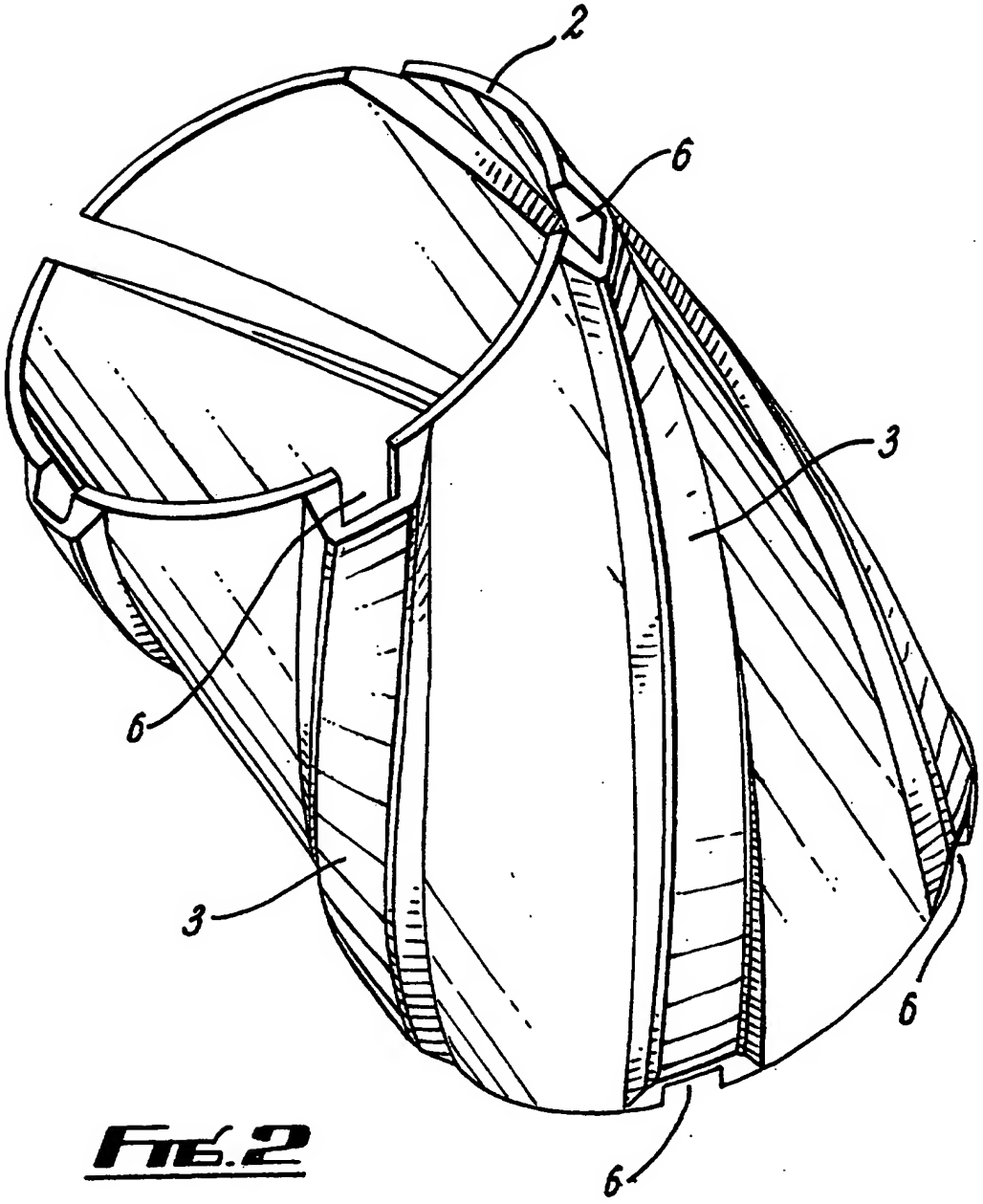


ФИГ.1



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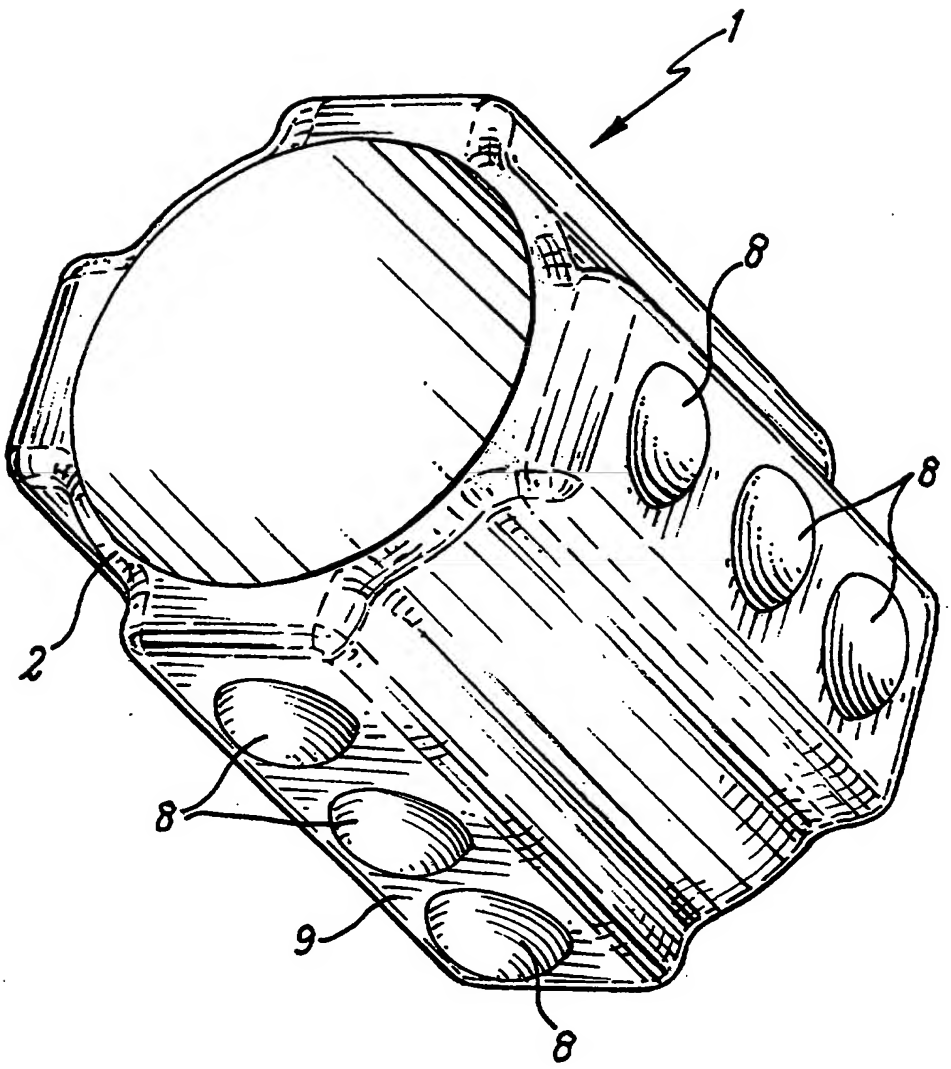

Фиг.3

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IMPROVED CASING CENTRALISER

The present invention relates to centralisers as are typically for centering casing and to assist in the task of cementing casing in oil or gas wells, wherein the centraliser is made from a cast polymer material.

It is conventional practice after drilling an oil or gas well to run tubing, known as casing, into the well bore to act as a liner. The casing stabilises and prevents the bore from collapsing inwards. The casing is run into the newly formed bore from the surface, and the annular space between the casing and the bore is then filled with cement. Typically, cement is pumped to the bottom of the bore from where it is displaced into the annular space between the external surface of the casing and the interior of the well bore. The cement acts as a sealant and also to structurally support the casing in place.

It will be appreciated that before the casing is cemented in place, it is important that the casing is held substantially central within the bore. This allows a strong cement bond to be formed around the casing by

ensuring that an even thickness of cement is displaced around the casing. Ensuring that the casing is in a central position within the bore also prevents channelling of the cement or the creation of void spaces, as often occurs if the casing rests against the wall of the wellbore during the cementing procedure.

It is known in the art that fitting a centraliser to the casing will support the casing or liner off the well bore wall. It will be appreciated that providing standoff is particularly important as well bores are never truly vertical and often contain sharp bends and deviations in direction. Typically, one or more centralisers are mounted on the outside of the casing as it is lowered into the bore to centre the casing. The centralisers act to reduce friction and create standoff from the well bore which allows the casing to be rotated and cemented in a satisfactory manner.

There are several types of centraliser known to the art. One commonly used centraliser is the bow type, which comprises hollow cylindrical components or two axially spaced apart collars which are interconnected by spring bows. So called rigid or solid centralisers have a fixed outer diameter and are therefore less flexible than the spring bow type centraliser. It is common to include a number of 'blades' around the body of solid centralisers. These are typically raised solid structures which extend longitudinally around the centraliser body which engage the well bore wall and optimise standoff and therefore aid the centralising action of the tool.

It is also becoming more common to incorporate rollers on the body of centralisers to aid the rotation of the centraliser and therefore prevent "sticking" and also to reduce friction, torque and drag which are afforded to the centraliser as it contacts the wall of the well bore. Whilst these rollers reduce the resistance and torque afforded to the casing and centraliser, they are limited in efficiency as the rollers must be mounted on either a vertical or horizontal axis.

Conventionally, centralisers are made from a strong metal material. It will be appreciated that centralisers are subject to huge loads, such as impact and shear forces, and accordingly must be durable and hardy. However although metal centralisers are able to withstand high loads and the hostile downhole environment, they are not particularly flexible. This is a disadvantage if the centraliser encounters obstructions as it is run through the well bore on the casing. For example it is not uncommon for ridges or ledges to form in the wall of a bore during drilling, or for debris to accumulate in as section of the well. Metal centralisers are generally not flexible enough to yield to such obstructions, and therefore there is a risk that the progress of the casing procedure will be halted and that the casing upon which the centraliser is mounted will become stuck. A further problem of metal centralisers lies in the fact that they are prone to corrosion. This is a particular problem as acid is often pumped into well bores to stimulate and clean the well.

The most important criteria for any material to be used in the manufacture of centralisers is that the material

must be strong enough to withstand the shear forces and high loads which are afforded to a centraliser in use, but must also flexible enough to manoeuvre obstructions in the well bore and yield under extreme load. The use of plastic centralisers has been suggested for this purpose. Previous attempts to manufacture plastic centralisers have commonly relied on two manufacturing processes, namely injection moulding and extrusion. These involve physically changing processed raw material plastic "pellets". The pellets are heated to a suitable temperature such that they are malleable for extrusion and then ejected under pressure into the desired shape of a casing centraliser. However it has been found that plastic centralisers manufactured in this manner are restricted in their ability to withstand force. In addition the "pellets" which are produced by the chemical industry for extrusion and injection moulding have undergone several condensate and extrusion processes to deliberately thin viscosity to enable processing in standard machinery. The high pressures and chilling used in these processes induces an amorphous non-crystalline structure to be produced and causes further degradation of the material which detrimentally affects the final strength and wear resistance of the centraliser.

It is an object of the present invention to provide a casing centraliser which is hard wearing but has sufficient compliance and resilience to negotiate a restriction in the wall of a well bore. A linked aim is to provide a centraliser which does not corrode. In particular, in the present invention it is recognised that the method of manufacture previously used to produce plastic centralisers can be improved so as to produce

centralisers which have superior flexibility and durability. It has been found that the described method is best carried out using polyamide material.

It a further object of the present invention to provide a casing centraliser which has superior means for reducing torque and friction afforded to the centraliser as it is advanced downhole. In particular it is an object of the present invention to provide a centraliser which has sufficient compliance and resilience to negotiate any unplanned restrictions in the well bore.

According to the present invention there is provided a centraliser for mounting on casing comprising an annular body having a plurality of blades around said annular body, and a longitudinal bore extending through the annular body, characterised in that the annular body is a cast polyamide material.

Preferably the longitudinal bore makes a clearance fit around the casing on which the centraliser is attached.

Preferably the polyamide is nylon.

Preferably the plurality of blades are hollow.

Preferably each of the plurality of blades has a number of integral ports which allow the flow of fluid into, and out of the hollow blade.

Preferably the blades may contain conduction means.

Optionally the conduction means are power lines.

Alternatively the conduction means are optical fibres.

Optionally the blades extend parallel to the length of the annular body.

Alternatively the blades extend longitudinally and helically around the annular body.

Preferably the blades are shaped in such a manner that they are separated by void areas which define a flow path which permits the relative by pass of fluid between each of the blades.

Optionally the annular body is rotatably mounted on the casing.

Preferably the centraliser has low friction means.

Most preferably said low friction means are ball bearings.

Preferably said ball bearings are mounted on a racer.

Preferably said ball bearings are mounted on the blades of the annular body.

Preferably the centraliser has connection means for mounting the centraliser on the casing.

Most preferably said connection means are threaded end connections which mate with the casing.

Preferably the centraliser has an internal diameter which is at least equal to, or greater than the diameter of the casing on which the centraliser is mounted.

Preferably the dimensions of the centraliser are not limited and could be adapted to be suitable for use with any size of casing.

According to a second aspect of the present invention there is provided a method of manufacturing a cast polyamide centraliser wherein a liquid polyamide is cast into an annular shaped body by monomer casting.

Optionally the polyamide centraliser is cast by centrifugally casting a liquid polyamide material.

Alternatively the polyamide centraliser is cast by gravity pouring a liquid polyamide material.

Preferably the liquid polyamide is directly polymerised to a solid.

Preferably the annular shaped body has a number of ball bearings.

Preferably said ball bearings are made from polyamide material.

Most preferably said ball bearings and annular body are manufactured in one procedure.

An example embodiment of the invention will now be illustrated with reference to the following Figures in which:

Figure 1 illustrates a cast polyamide centraliser in accordance with the present invention;
Figure 2 illustrates a cast polyamide centraliser with an alternative port configuration; and
Figure 3 illustrates a cast polyamide centraliser with friction reducing means.

Referring firstly to Figure 1 a cast polyamide centraliser is generally depicted at 1 and comprises a polyamide annular body 2, which is essentially cylindrical and hollow and which can be mounted onto a casing string (not shown). The polyamide used may be nylon. The annular body 2 is at least the same size as the casing it is to be attached to and makes a tight fit around the casing (not shown). The annular body may be able to rotate or may remain stationary relative to the casing. The annular body 2 has a plurality of raised blades 3 which extend longitudinally and helically around the annular body 2. The blades are also produced from a polyamide material, typically the same polyamide as the annular body 2. The blades 3 provide maximum standoff when the centraliser 1 is in position on a casing or liner (not shown) in a well bore. Although the blades illustrated in Figure 1 extend longitudinally and helically around the annular body 2 it will be appreciated that in an alternative embodiment the blades may extend longitudinally and parallel to the annular body 2. An advantage of the present invention is that the blades 3 are hollow and have a number of ports 4 into and

out of which fluid can flow. The fluid may include drilling fluid, cleaning fluid, carrier fluids or gels used for gravel packing operations such as are continuously passed through the section of well being bored to lubricate the drilling apparatus and wash out the bore. The ports 4 may be positioned on the wall facing surface 5 of the blades or, in an alternative embodiment shown in Figure 2, may be located at the ends of the blade 6. Because the blades are hollow, they may be used as a conduit or housing to protect conduction means such as power lines, electrical cables or optical fibres. A further advantage is that the plastic hollow blades have a greater flexibility and compliance than convention metal solid blades and can therefore negotiate any obstructions countered in the wall of the bore.

The advantage of the present invention over the prior art is that the polyamide material offers a substantially lower co-efficient to friction whilst being run in the well, and has superior compliance and resilience to metal centraliser. The polyamide centraliser also has superior ability to yield to any obstructions met in the path of the casing, over metallic centralisers.

An important aspect of the present invention is the process by which the plastic centraliser is produced. Previous attempts to produce a plastic centraliser have used extrusion techniques or injection moulding with pre processed raw material plastic pellets. However it is generally recognised that such plastic centralisers are less efficient at withstanding the huge loads and impacts encountered in the downhole environment. In the present invention, monomer casting is used to produce a superior

and more efficient plastic centraliser. In the present invention it is also recognised that the described manufacturing process is best carried out using a polyamide material. The monomer casting is carried out using three lactums, namely caprolactum, capryllactam and laurinlactum along with catalysts and activators. The polyamide produced by monomer casting has a greater crystalline structure, superior viscosity and greater molecular weight than injected or extrusion materials. The polyamide therefore has an increased strength and wear resistance and is better suited to withstand the torque and drag afforded to a centraliser in the downhole environment. The castings may be produced from centrifugal casting, or gravity pouring for greater density. The cast polyamide manufactured by this process can also survive higher temperatures and pressures. A particular advantage of this manufacturing process lies in the fact that in order to monomer cast the polyamide centraliser, a liquid polyamide has to be used. This is in contrast to earlier attempts to produce a plastic centraliser which used pre-processed plastic "pellets". Therefore in the present invention, the manufacturing costs are reduced as there is no requirement for pre-processing the material, and the polyamide is directly polymerised from a liquid chemical form to a solid object in its mould.

Figure 3 illustrates a cast polyamide centraliser 1 which has a plurality of ball bearings 8 located on the externally facing surface of the annular body 2. In the depicted embodiment the ball bearings 8 are located on blades 9 which extend longitudinally and parallel to the annular body. The ball bearings 8 minimises the torque

and friction which is afforded to the annular body 2 of the centraliser, particularly when the centraliser is rotating, or is being rotated in the borehole or inside of a casing string Most importantly, the ball bearings 8 reduce the friction afforded in any direction on the tool 1. This is in contrast to roller reamers which have been used in the past to reduce friction, but which can only be mounted on a vertical or horizontal axis and can therefore only minimise friction which is afforded in these directions. In one embodiment the ball bearings may be incorporated into the annular body 2 as a ball bearing racer which allows the ball bearings to 'race' around the outer circumference of the centraliser.

It is recognised in the present invention that the ball bearings may be manufactured from the same material as the annular body, that is polyamide and therefore the body 2 and blades 3, and the ball bearings 8 may be manufactured at the same time and as a whole.

The advantage of the present invention is that by using a casting process to manufacture a centraliser from a polyamide material, it has been found that a non-metallic centraliser can be produced which is durable, resilient and compliant and which does not have the inherent problems of conventional metal centralisers, notably the risk of corrosion, and low flexibility. Furthermore, the blades which allow optimum standoff of the centraliser from the well bore are hollow and therefore have increased flexibility and can be used to house power lines and other conduction means.

A further advantage is that the use of ball bearings in the present invention aids rotation of the centraliser and minimises friction in all directions.

The present invention is described for use on casing. However it is recognised that the centraliser may be adapted for use on any type of work string which is used in a downhole bore, such as liner, tubing or drill string.

An alternative production technique could be that of reaction moulding which is also a system of low pressure casting by polymerisation in the mould using catalysts in a similar manner to monomer casting, but with the advantages of more complicated and defined sections.

Further modifications and improvements may be incorporated without departing from the scope of the invention herein intended.

Claims:

1. A centraliser for mounting on casing comprising an annular body having a plurality of blades around said annular body, and a longitudinal bore extending through the annular body, characterised in that the annular body is a cast polyamide material.

2. A centraliser as claimed in Claim 1, wherein the longitudinal bore makes a clearance fit around the casing on which the centraliser is attached.

3. A centraliser as claimed in Claim 1 or Claim 2, wherein the polyamide is nylon.

4. A centraliser as claimed in any one of the preceding Claims, wherein the plurality of blades are hollow.

5. A centraliser as claimed in Claim 4, wherein each of the plurality of blades has one or more integral ports which allow the flow of fluid into, and out of the hollow blade.

6. A centraliser as claimed in any one of the preceding Claims, wherein the blades contain conduction means.

7. A centraliser as claimed in Claim 6, wherein the conduction means are power lines.

8. A centraliser as claimed in Claim 6, wherein the conduction means are optical fibres.

9. A centraliser as claimed in any one of the preceding Claims, wherein the blades extend parallel to the length of the annular body.

10. A centraliser as claimed in any one of Claims 1 to 8, wherein the blades extend longitudinally and helically around the annular body.

11. A centraliser as claimed in any one of the preceding Claims, wherein the blades are shaped in such a manner that they are separated by void areas which define a flow path which permits the relative by pass of fluid between each of the blades.

12. A centraliser as claimed in any one of the preceding Claims, wherein the annular body is rotatably mounted on the casing.

13. A centraliser as claimed in any one of the preceding Claims, wherein centraliser has low friction means.

14. A centraliser as claimed in Claim 13, wherein said low friction means are ball bearings.

15. A centraliser as claimed in any one of the preceding Claims, having connection means for mounting the centraliser on the casing.

16. A centraliser as claimed in Claim 15, wherein said connection means are threaded end connections which mate with the casing.

17. A centraliser as claimed in Claim 15 or 16, wherein the centraliser has an internal diameter which is at least equal to, or greater than the diameter of the casing on which the centraliser is mounted.

18. A method of manufacturing a cast polyamide centraliser wherein a liquid polyamide is cast into an annular shaped body by monomer casting.

19. A method as claimed in Claim 18, wherein the polyamide centraliser is cast by centrifugally casting a liquid polyamide material.

20. A method as claimed in Claim 18, wherein the polyamide centraliser is cast by gravity pouring a liquid polyamide material.

21. A method as claimed in any one of Claims 18 to 20, wherein the liquid polyamide is directly polymerised to a solid.

22. A method as claimed in any one of Claims 18 to 20, wherein the annular shaped body has a number of ball bearings, wherein said ball bearings are also made from polyamide material, and wherein the ball bearings and annular body are manufactured in one procedure.